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(54) HAMMER DRILL

(71) We, HILTI AKTIENGESELLSCHAFT, a Corporation organised and existing under the laws of the Principality of Liechtenstein, of Schaan, Liechtenstein, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a hammer drill in which the driving force is split up into rotary motion for rotating a tool and impact motion directed in the direction of the axis of the tool, there being provided, for transmission of the rotary motion, between a tool-holder and a drive wheel, a drive cylinder which is associated with the tool-holder and which carries a coupling part which is connected in a torsionally-fast manner to the drive cylinder and which can be brought, by axial displacement by means of a setting member, into a coupling position in which it is coupled with the drive wheel, into an idle rotary position, and into a position in which it is coupled to a housing of the hammer drill.

With hammer drills, more especially those of better performance class, there is an increasing demand that the tool, in addition to being usable for drilling use, should also be suitable for chiselling. This is a matter, accordingly, of imparting rotary motion to, or of preventing rotary motion of, a tool present in the usual tool-holder of the hammer drill, depending on the kind of tool involved. To ensure problem-free handling, and in order to permit the insert ends of the tools to be uniform, it is advantageous if the rotary disengagement is effected by a mechanism which is simple to operate. It is more especially also required of such a mechanism that, when the rotary drive is interrupted, locking of the tool-holder or of the tool in a desired rotary position is possible, in order for example when using a flat chisel, to be able to guide the chisel in the proper working manner.

In one known hammer drill, rotary motion of a pinion, driven from a motor, is transmitted to a bevel gear which meshes with the pinion and which, for its part, is arranged so as to be rotatable concentrically on a cylinder which serves to guide a piston of the impact mechanism. The bevel gear has, on its end face lying opposite toothing meshing with the pinion, entrainment means which can, in turn, be brought into engagement with a coupling part which is torsionally fast and axially displaceable on the cylinder. The coupling part is then held in the engagement position by a compression spring which is supported on the housing of the hammer drill. A setting member acts on a shoulder of the coupling part, which setting member is designed as an eccentric handle rotation of which serves to bring the coupling part out of engagement with the bevel gear against the spring force. The coupling part has a jacket which is of hexagonal configuration, a surface of the eccentric being applied against a respective one of the six portions of the jacket surface in the uncoupled position of the coupling part. As a result, the coupling part is locked against rotation as well as the cylinder and the tool-holder, and is connected in a torsionally fast manner at the front to the cylinder. In further operation of the hammer drill, accordingly, only impact energy is imparted to the tool.

This kind of rotary disengagement or locking has considerable disadvantages. Thus, the hexagon of the coupling part affords the possibility of locking only in six positions. This is unsatisfactory from the point of view of handling. However, because of the high stresses imposed on the locking surfaces of the coupling part and the eccentric handle, a polygonal design, of the coupling part, having more than six sides is not to be recommended. The hexagonal design has, in addition, the disadvantage that it freqently occurs that the surface of the eccentric intended for the locking, instead of engaging with a surface, encounters an edge of the hexagon and locking is accordingly possible only after further rotation of the tool-holder by means of the tool. A further negative aspect of this solution

lies in the fact that the eccentric handle performs only the uncoupling of the coupling part, while the aforementioned compression spring is necessary for the coupling. Apart from the disadvantage of the use of a plurality of components, the incorporation of a compression spring additionally makes it necessary for the overall length of the apparatus to be rather large.

The problem underlying the invention is to provide a hammer drill having a locking arrangement for the tool, enabling it to be used as a chisel, which is of simple construction and has a high force absorption capability.

In accordance with the invention there is provided a hammer drill, in which the driving force is split up into rotary motion for rotating a tool and an impact motion directed in the direction of the axis of the tool, there being provided, for transmission of the rotary motion, between a tool-holder and a drive wheel, a drive cylinder which is associated with said tool-holder and which carries a coupling part which is connected in a torsionally-fast manner to said drive cylinder and which can be brought, by axial displacement thereon by means of a setting member, into a coupling position in which it is coupled with the drive wheel, into an idle rotary position, and into a position in which it is coupled relative to a housing of the hammer drill, characterised in that, for effecting the coupling relative to the housing the coupling part has, on an end face remote from the drive wheel, projections or recesses which can be brought into engagement with complementary recesses or projections associated with the housing.

Because of the presence of a plurality of the projections or recesses, a corresponding number of rotary or locking positions of the tool can be provided. Furthermore, the cooperating projections and recesses provide also a highly stressable positive connection between the coupling part and the housing, since the forces involved are distributed among all the projections or recesses. Also the determination of the individual locking positions is problem-free, especially if a rounded design is adopted for the projections or the recesses since then interengagement of the same is simple and straightforward.

A further advantage of this solution lies in the fact that the displacement of the coupling part can be brought about, solely by the setting or adjusting member, which may for example be a slide, so as to bring it into the coupled or locked position, without the use of compression spring which has a disadvantageous effect on overall length.

Advantageously the coupling part is of substantially hollow-cylindrical configuration, being for example, a bushing. In this respect, it is a question of a part which can be produced in an exceptionally simple manner. In order to provide, on the one hand for securement against rotation of the coupling part relative to the drive cylinder and, on the other hand, axial displaceability of the coupling part relative to the drive cylinder, the connection between the coupling part and the drive cylinder is advantageously provided by a spline or key of the kind already known as an engineering component.

In a simple and proven manner, the projections or recesses of the coupling part and of the housing can be formed by complementary claw-toothed rims. The "finding" of the respective desired locking positions is facilitated if the flanks of the toothed rims are bevelled so as to taper upwards.

The claw-toothed rim associated with the housing may be worked directly into the housing or may, for example, be part of a locking ring which is connected in torsionally fast manner to the housing.

Since in this manner of connecting the coupling part and the housing functionally, there is a positive coupling connection which is suitable for the transmission of large forces, in accordance with a further preferred proposal of the invention it is advantageous, for the mutual coupling of the coupling part and the drive wheel, if also in each case a further claw-toothed rim is provided on these parts for the transmission of the rotary drive.

Advantageously the coupling part has an annular groove which serves for the engagement therewith of an eccentric cam or dog of the setting member. The arrangement of the eccentric cam or dog on the setting member is, in this respect, preferably selected in such a way that, upon 90° rotation of the setting member in the one or other direction of rotation, the coupling part meshes with the drive wheel or, for locking the rotary position, engages into the craw-toothed rim associated with the housing. The setting member may have, for its actuation, a swivel knob which can be operated, for example, on the outside of the housing. The individual functional positions of the setting member are then advantageously defined by detent means.

One achieves a constructionally extremely simple and advantageous embodiment, if the coupling part surrounds a drive cylinder which is associated with the tool-holder. The drive cylinder may then either enclose an inner cylinder serving for guidance of pistons of an impact mechanism of the drill or itself undertake the guidance of the pistons. In this connection, it is possible to design the tool-holder in one piece with the drive cylinder or to provide a connection, for example a screw connection to ensure the necessary functional integrity. In these instances, the drive cylinder undertakes the transmission of torque, transmitted via the coupling part and the spline or key to the tool-holder or the clamped tool.

The invention will be described further, by

way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a part-sectional side elevation illustrating a preferred embodiment of the hammer drill of the invention, the parts beng shown in their positions corresponding to use of the drill for hammer drilling;

Fig. 2 is a view similar to Fig. 1, but showing the parts in their positions corresponding to idle rotation (and non-impacting) of the tool;

Fig. 3 is a view similar to Figs. 1 and 2 but showing the parts in the locking position.

The hammer drill shown in Fig. 1 comprises a housing 1 having a nuzzle attachment 1*a*. A tool-holder 2 is mounted in the housing 1, for rotation, by way of a drive cylinder 3 screwed thereto, this, at the front by a ball bearing 4 and at the rear by a roller bearing 5. Guided at the rear in the drive cylinder 3 is an actuating piston 6 which has a reciprocating motion imposed on it by means of a connecting rod 7 which is shown only diagrammatically. The actuating piston 6 carries an elastic sealing ring 6*a* which butts against the drive cylinder 3. In front of the actuating piston 6 in the drive cylinder 3 there is, furthermore, an impact piston 8 which has a respective sealing ring 8*a*.

In the cylinder chamber present between the actuating piston 6 and the impact piston 8 there exists an air cushion which, when the actuating piston 6 is caused to reciprocate, causes the impact piston 8 correspondingly to be set in reciprocating motion. Free mobility of the impact piston 8 is ensured by compensation bores 3*a* which on the one hand, upon forward movement of the impact piston 8, guarantee flow-off of the air present in front of the impact piston 8 and on the other hand, upon return of the impact piston 8, ensure a re-flow of external air into the front cylinder chamber. The impact piston 8 acts on or impinges on the rearward end of an inserting shaft end or shank 9, introduced into the tool-holder 2, of tool which, for permitting rotary entrainment, is hexagonal in cross-sectional configuration in correspondence with the tool-holder 2. The tool is secured by a spring yoke or stirrup 11 arranged on the attachment 1*a* on the housing, against undesired dropping out from the tool-holder 2.

Rotary drive is imparted to the tool from a motor-driven pinion 12 which is mounted by a ball bearing 13 in the housing 1 and meshes with a drive wheel in the form of a bevel gear 14. The drive wheel, designed as a bevel gear 14, is arranged concentrically and freely rotatably on the drive cylinder 3, a locking washer 15 preventing any axial displacement. At the forward end face it has a claw-toothed rim 14*a* which engages with its projections or recesses into a further claw-toothed rim 16*a* of a coupling part 16 which surrounds the drive cylinder in the form of a hollow cylindrical bushing. The coupling part 16 is displaceable relative to the drive cylinder 3 and is connected in torsionally fast manner by a spline or key 17. The insertion shaft end or shank 9 accordingly is subjected to rotary motion from the pinion 12 via the bevel gear 14, the coupling part 16, the spline or key 17, the drive cylinder 3 and finally the tool-holder 2. In order to achieve efficient sealing between the attachment 1*a* and the rotating tool-holder 2, an elastic sleeve seal 18 is provided between these parts. Furthermore, the tool-holder 2 is supported, relative to the housing 1, by a further roller bearing 19 which absorbs axial forces.

The coupling part 16 is held in engagement with the bevel gear 14 by a setting (or adjusting) member which is designated as a whole by the numeral 21. This setting member 21 is composed of an indexing bolt 22 mounted so as to be rotary and limitedly axially displaceable in the housing and having an eccentric cam lobe or dog 22*a* which latter engages into an annular groove 16*b* in the coupling part 16. The indexing bolt 22 is loaded by a cup spring 23 which, for its part, is supported against a disc 24 on the housing, with the eccentric cam lobe 22*a* engaged into the annular groove 16*b*. The indexing bolt 22 can be brought into the desired rotary position by means of a swivel knob 25 which is connected in torsionally fast manner to the indexing bolt 22, thereby causing the coupling part 16 to shift correspondingly on the drive cylinder 3.

Fig. 2 shows the setting member 21 in a position pivoted through 90° relative to the position shown in Fig. 1. The indexing bolt 22 has shifted the coupling part 16 forwards, i.e. towards the tool, and in so doing has brought the claw-toothed rims 14*a* and 16*a* respectively out of engagement, so that transmission of rotary drive from the bevel gear 14 to the drive cylinder 3 or the insertion shaft end or shank 9 is interrupted. The tool together with the tool-holder 2 as well as the drive cylinder 3 can be rotated freely relative to the housing 1; it is thus in an idle rotary position. In this position, only impact energy is imparted to the tool when the apparatus is in operation.

The coupling part 16 carries, at its front end face, a further claw-toothed rim 16*c* which can be brought into engagement with a complementary claw-toothed rim 26*a* of a locking ring which is connected fixedly to the housing 1 via a pin 27.

In Fig. 3 the locking position achieved by further rotation of the setting member 21 is shown, i.e. the coupling part 16 has been shifted towards the locking ring 26, so that the claw-toothed rims 16*c* and 26*a* intermesh. Also in this operational position of the apparatus, no rotary motion is transmitted from

the bevel gear 14 to the tool shaft 9. On the contrary, the free rotatability of the tool is prevented by the positive co-operation of the coupling part 16 and the locking ring 26. The tool acted upon by the impact mechanism, which is, for example, a flat chisel, can thus be guided by means of the hammer drill in a proper manner so far as concerns handling and use. The locking position of the tool in the hammer drill can be selected at will, by the chisel tool first of all being introduced into the tool-holder 2 in the idle rotary position shown in Fig. 2 and then being pivoted into the desired rotary position and then the setting member 21 being brought into the locking position which can be seen in Fig. 3.

WHAT WE CLAIM IS:—

1. A hammer drill, in which the driving force is split up into rotary motion for rotating a tool and an impact motion directed in the direction of the axis of the tool, there being provided, for transmission of the rotary motion, between a tool-holder and a drive wheel, a drive cylinder which is associated with said tool holder and which carries a coupling part which is connected in a torsionally-fast manner to said drive cylinder and which can be brought, by axial displacement theeon by means of a setting member, into a coupling position in which it is coupled with the drive wheel, into an idle rotary position, and into a position in which it is coupled relative to a housing of the hammer drill, characterised in that, for effecting the coupling relative to the housing the coupling part has, on an end face remote from the drive wheel, projections or recesses which can be brought into engagement with complementary recesses or projections associated with the housing.

2. A hammer drill as claimed in claim 1, chaacterised in that the coupling part is of hollow-cylindrical configuration.

3. A hammer drill as claimed in claim 1 or 2, characterised in that the projections or recesses of the coupling part and those associated with the housing respectively are formed by complementary claw-toothed rims.

4. A hammer drill as claimed in claim 1, 2 or 3, characterised in that the coupling part and the drive wheel have, for mutual coupling, claw-toothed rims which can be brought into engagement with one another.

5. A hammer drill as claimed in any preceding claim characterised in that the coupling part has an annular groove which serves for the engagement therewith of an eccentric cam or dog of the setting member.

6. A hammer drill substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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1576795 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

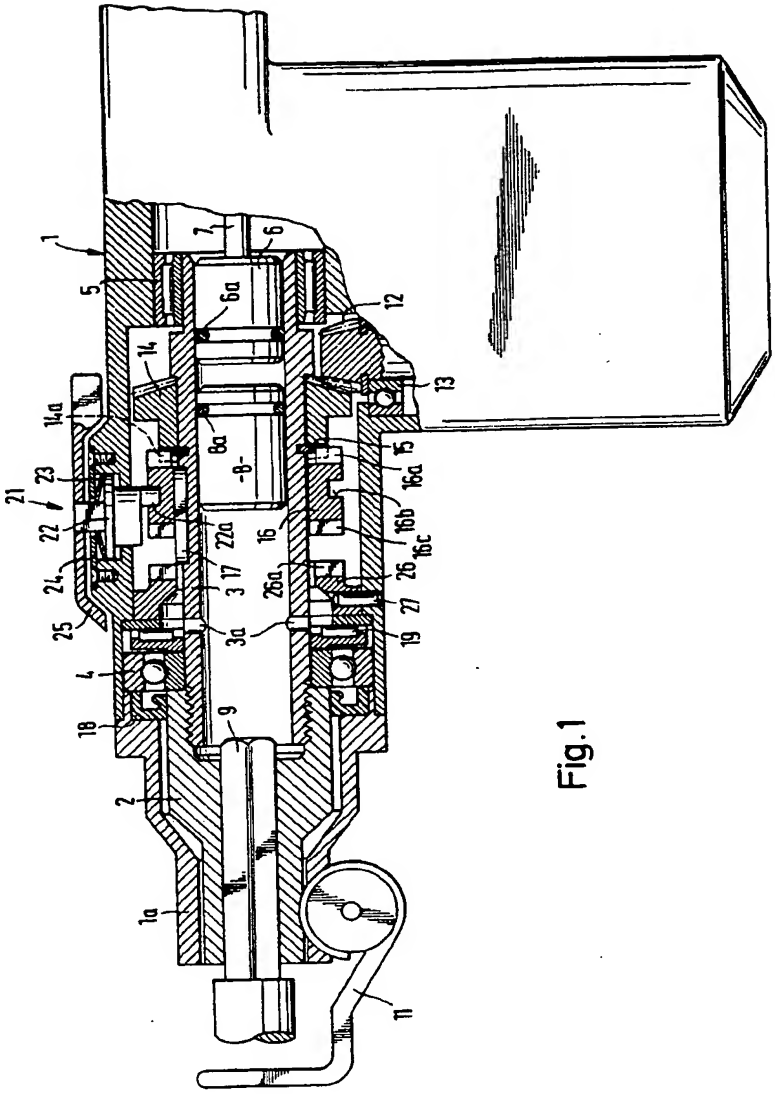

Fig.1

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Sheet 2

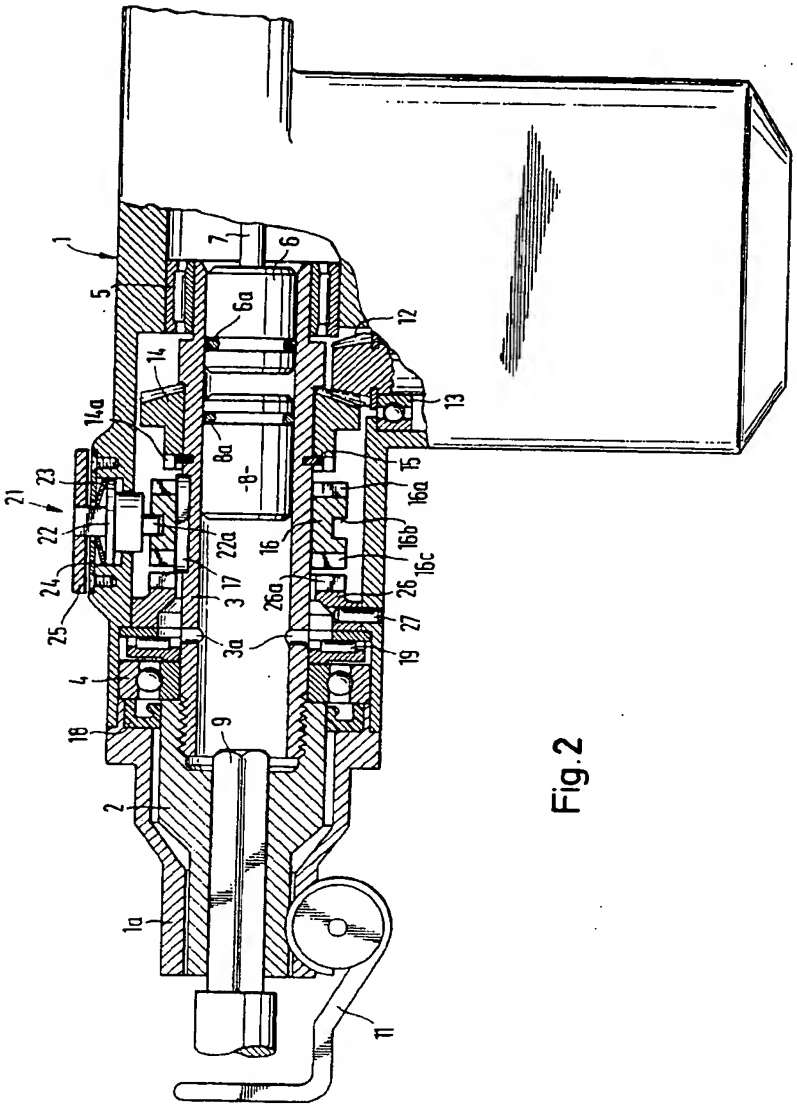

Fig.2

1576795 COMPLETE SPECIFICATION

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Sheet 3

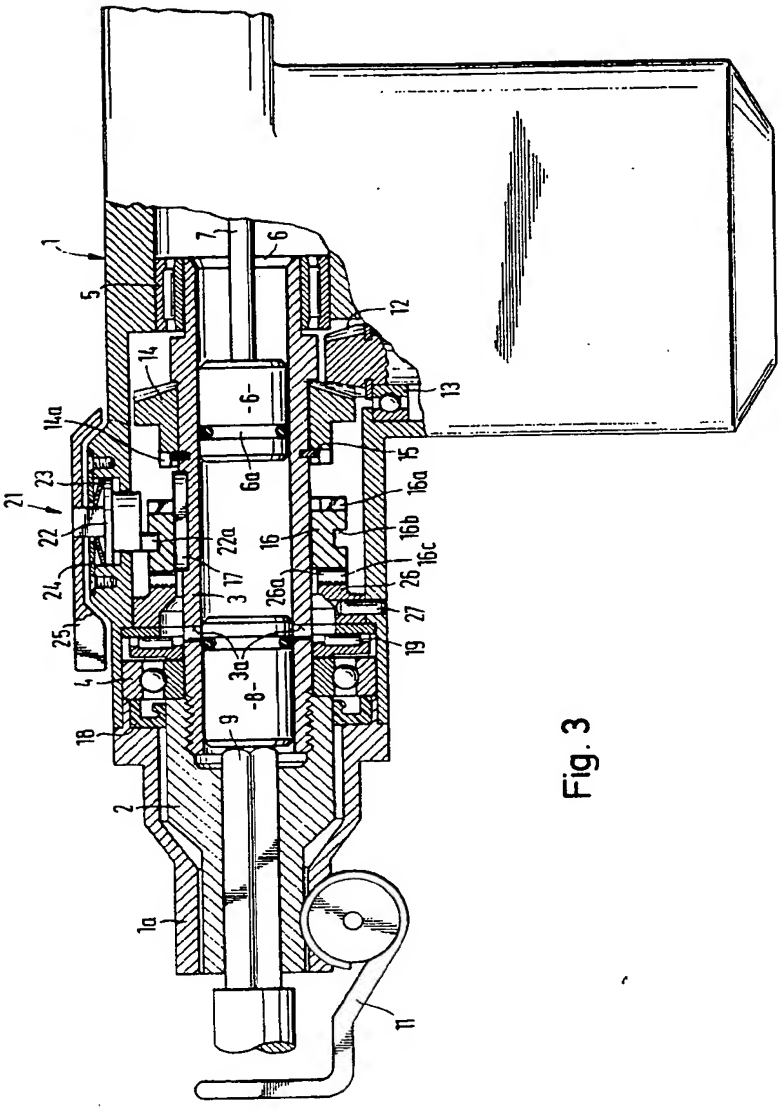

Fig. 3